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OVERSPEEDING AND CRASH DETECTION SURVEILLANCE ON HIGHWAYS

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ABSTRACT

The proposed system is an ideal solution to the global concern of overspeeding. It combines an overspeeding indicator and an Automatic Crash Detection and Emergency Alert System (ACDEAS) to promote safe driving. The system forthwith alerts the drivers when they exceed speed limits. On the other hand, the ACDEAS system perceives crashes and alerts the authorities concerned without further ado for quick medical response. This approach remarkably reduces overspeeding-related accidents, minimizes fatalities, and alleviates the financial and societal costs of traffic accidents. It plays a significant role in improving public welfare and road safety.

Keywords: Automatic Crash Detection and Emergency Alert System (ACDEAS), smart vehicle monitoring system (SVMS). GPS, and GSM

I. INTRODUCTION

Overspeeding, a notable factor in accidents and fatalities, is a persistent concern for everyone. We provide a novel solution to this problem: an overspeeding indicator combined with an Automatic Crash Detection and Emergency Alert System (ACDEAS). It permits the prevention of accidents and medical aid when an accident occurs.

The Overspeeding Indicator continuously tracks and evaluates a vehicle's speed concerning established speed limits. The system transmits alerts, including auditory warnings and visual signals, to the driver when he exceeds these limitations, motivating the driver to slow down and follow safe driving protocols.

Additionally, the system's ACDEAS component goes beyond speed monitoring. The system, equipped with crash sensors, can recognize abrupt deceleration suggestive of a collision in the case of a deadly accident. The ACDEAS immediately notifies the nearest toll booth or emergency response centre of the crash. This alert helps the authorities provide quick medical aid to the injured by providing crucial details, including the vehicle's GPS location, vehicle identification number (VIN), and severity of the incident.

The combined Overspeeding Indicator and ACDEAS system seeks to lower the probability of overspeeding-related incidents while ensuring quick reaction and medical aid for accident victims. This technology contributes substantially to road safety and the general well-being of drivers and passengers by encouraging safer driving behaviour and facilitating quick emergency responses. Implementing this system can prevent fatalities and lower the financial and social costs of traffic accidents.

II. LITERATURE REVIEW

In 2022, Yede Abhishek Kailas et al [1] developed an alert system for accidents on highways built on 4G LTE, which is fast and reliable. The system uses a shock sensor that detects heavy shocks during accidents. Then, by using GPS, it calculates the coordinates of the vehicle and raises an alert to the mobile application. Through the GSM module, the data is sent to emergency contacts. Even though the system is fast, the power consumption of components is a significant concern, and it can store an emergency contact number of 2 members, which makes it non-reliable when alerts to the two contact numbers are not reached due to network congestion.

Alok Beheramali and Subhendu Sekhar Sahoo [2] have published a paper about an IoT-based system that can detect and alert car accidents using sensors, GPS, and GSM modules. The system can send the location and severity of the accident to the subscribed contacts, such as relatives, friends,

police, or ambulance. The system can also prevent car theft by immobilizing the ignition motor through a message from the owner's mobile device or laptop. The paper claims the system can enhance vehicle safety, provide prompt emergency assistance, and save lives.

In 2022, K. Tejaswini and S. Sreenivasa Rao [3] proposed a system to coordinate quick responses to road accidents; vibration and gyro sensors are used to detect accidents. The system utilizes GPS and GSM modules to identify the accident location and send alert messages. Distance Vector Routing Algorithm determines the closest location and sends notifications to the involved parties for prompt response. Ultimately, this paper emphasizes the system's capability to quickly identify and communicate accident details to facilitate immediate responses, reducing communication delays and allowing for prompt treatment of accident victims. High power consumption and Privacy concerns are major setbacks involving this system.

In 2019, Mohammad Ahmar Khan et al [4] published a study addressing vehicle overspeeding, which is the root cause of road accidents. The study provides the solution using IOT. This smart device uses GPS, Raspberry Pi, and Android OS to detect and report speeding violations. The system presents a plan combining a GPS module and Google Maps to obtain information about the speed limit of a particular location. The Google Maps Roads app allows you to plot GPS coordinates on the road shapes and set vehicle speed limits on each road section. Overall, this study provides an overview of using IOT-based solutions to improve road safety through speed monitoring.

In 2020, students of Savitribai Phule Pune University (SPPU) Sandip Institute of Technology & Research Center Nashik [5] introduced a system called speed checker. The paper focused on designing a speed monitoring system to monitor the speed of vehicles on highways. Report illegal speeds to the central server if the driver continues at high speeds. They used an ESP8266 microcontroller to send the data to the cloud admin, which the police authorities can access. By this, police can perform their duties while sitting in the control room and provide service more efficiently and accurately. The system also has disadvantages, as the ESP needs Wi-Fi support to send data to the server.

In 2023, Karuna et al published a paper about a motorcycle crash detection and alert system using IoT. It describes how the system uses a multi-axes accelerometer to sense when the motorcycle falls to its side and sends the impact data to the Firebase cloud. If the data meets the crash criteria, the system alerts the emergency contacts and the emergency response services. The paper also explains the hardware and software components of the system, the testing and evaluation methods, and the future scope of the project. The report aims to reduce the fatality rate of motorcycle accidents by providing timely assistance to the victims.

In 2018, S. Kumar Reddy Mallidi and V. V. Vineela [7] developed a smart vehicle monitoring system (SVMS). Architecture involves using Raspberry Pi with sensors, including an accelerometer and an impact sensor, to detect accidents. A camera is also integrated for capturing images during an accident. Machine learning-based image classification is employed to determine the severity of accidents. The system is equipped with GPS and GSM modules to track the vehicle's location and communicate with authorities continuously. The SVMS framework includes a web server providing a user interface for remote access and control. This paper claims that SVMS offers immediate accident detection with severity classification, enabling prompt medical attention and reducing accident-related deaths and injuries. It also additionally aids in vehicle theft prevention. Limited data sets prove to be a significant setback as they cause inefficient training of the ML model.

In 2023,shermila et al [8] published a study that proposes a vehicle safety system using different sensors and various parameters. The sensors are used to sense abnormalities in the vehicle. The sensors used here are a temperature sensor, a crash sensor, and a gas sensor. The crash sensor detects the collisions between vehicles. The gas and temperature sensors detect the abnormalities. GPS is also used for tracking the vehicle's location in an emergency. If any abnormalities are sensed by the temperature, gas, or crash sensors, the microcontroller receives the data. The GPS location of the vehicle is sent to the microcontroller. As a result, accidents are identified and investigated using the above sensors. The SD card module is used to store the data from the sensors, which are used by police to investigate the cause of accidents. The collected data through GSM and IOT is transmitted to the hospital and police. The data is stored in the black box for future analysis.

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III.STATISTICS SURVEY:

The Bangalore-Mysore expressway project has been divided into two phases. Phase 1 spans from Bengaluru to Nidaghatta, covering a distance of 58 km. On the other hand, Phase 2 stretches from Nidaghatta to Mysore, covering a distance of 61 km. This project includes various infrastructure elements such as 50 underpasses for cars and pedestrians, 19 large bridges, 44 small bridges, and four railway overbridges (ROBs). Additionally, it incorporates greenfield sections that serve as bypasses around several cities including Bidadi (7 km), Mandya (10 km), Srirangapatna (7 km), Ramanagara-Channapatna (22 km), and Maddur (7 km with 3.5 km of elevated roadway).

The existing speed limit is 100 kilometers per hour. Nevertheless, in certain areas, the speed limit is reduced to 80 kilometers per hour. The NHAI has installed signs indicating the maximum speed limit on the designated median.

The below-given data is from traffic police stations at Kumbalagudu, Bidadi, Ramanagar, and Channa Patna, which is data ranging from 2017 to 2022 collected by Sanketh Gowda et al [9]

Table 1: Road Accident Statistics of Selected Stretch

Police Station	No of accidents	Fatality	Minor injuries	Major injuries
Bidadi	165	162	8	0
Channapatna	124	179	65	109
Kumbalagudu	77	111	26	42
Ramanagar	248	180	64	86
Total	614	632	163	237

Fig.3 Road Accident Statistics of Selected Stretch, 2022[9]

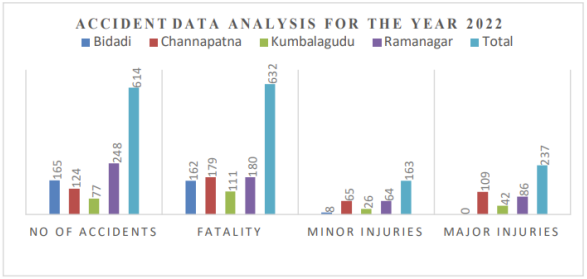

Fig.1 Data Analysis of Accidents, 2022[9]

The accidents are pretty high and more frequent because of the following reasons:

1. Improper signage and markings: Because of this, the drivers don't get to know about the speed limits in different regions, so they Overspeed
2. High-speed vehicles: the paper has Spot Speed Data and analysis with the experiment observed that the vehicle's speed was higher as per IRC standards.
3. Poor road design and maintenance: guardrails were missing, and medians needed to be adequately maintained. The drainage facility and road surface conditions are also not satisfactory.

These are the most significant reasons for the high rate of accidents.

IV.METHODOLOGY

The solution is divided into two parts

1. Overspeed Detector and Alert System
2. Crash Detection

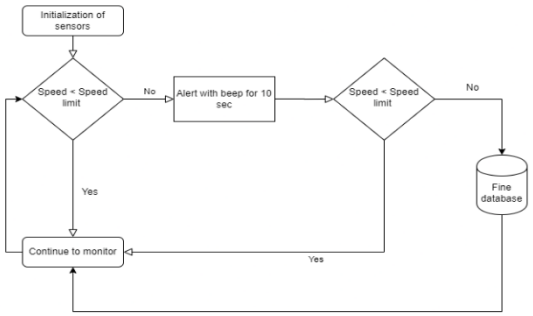

Fig.2 Overspeed Detector and Alert System

The Overspeed detector uses a GPS module to get the real-time speed of the vehicle. It continuously compares it with a speed limit existing in that particular region of the road. When the driver 1st time tries to drive above the speed limit, there will be a 10-second beep through the buzzer to indicate that they are overspeeding. If the driver still moves at a speed above the limit, data about the fine amount is sent to the database, which is later collected at the other end of the toll. The fine amount is sent to the cloud using the GSM module, which depends on the duration of overspeeding.

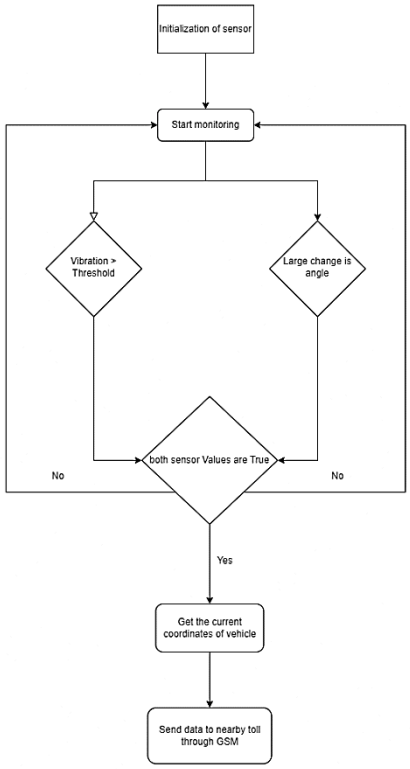

Fig.3 Crash Detection

The crash detection is equipped with a vibration and accelerometer sensor. The vibration sensor monitors the vibration of the entire vehicle and triggers when it detects a considerable volume of sudden vibration. In the same way, the accelerometer monitors the angles of the vehicle in 3 dimensions. When there is a massive change in any one of the dimensions, it gets triggered. If both the sensors are triggered, the system concludes it is an accident. The system collects the exact coordinates of the vehicles, and by using the GSM module, the coordinates, along with an altered message, are sent to the nearest toll. There will be a dedicated emergency service through which the victim can be hospitalized and saved from loss of life.

V. Conclusion

The literature survey demonstrates a variety of strategies for enhancing traffic safety with IoT-based technologies. Essential topics covered in studies include response coordination, accident avoidance, and detection. While real-time communication and help are made possible by technologies such as the motorbike crash detection system and the 4G LTE-based warning system, issues like power consumption and privacy concerns still exist. Notable initiatives have also been made to reduce excessive speeding and improve general vehicle safety. The constraint of data sets on machine learning models (SVMS) performance is still a significant issue. While there is still an opportunity for more research and development, taken as a whole, these studies offer insightful information that can help develop complete and efficient solutions for road safety.

Our system stands out from the rest as we look to tackle overspeeding and crash accidents compared to the referred studies that only focus on either one. Our system is a product of various technologies in IoT, ML, and Web domains. Ultimately, we look to fix the mindset of the people through punishment or penalty rather than mechanically or forcibly ensuring avoidance.

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